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Hard Mast Survey
Great Smoky Mountains National Park

Introduction

Hard mast is the most important fall food for wildlife in Great Smoky Mountains National Park (GRSM). Annual variations in hard mast production affect food habits, movements, habitat preference, reproduction, and, therefore, density of black bears (*Ursus americanus*) in GRSM (McLean 1991). Hard mast also is an important fall food for other wildlife species including white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), chipmunks (*Tamias striatus*), squirrels (*Sciurus carolinensis, Tamiasciurus hudsonicus*), wild hogs (*Sus scrofa*), and elk (*Cervus elephas*).

Since 1979, hard mast surveys have been used to collect baseline information for assessing and monitoring mast production in GRSM (Nicholas and White 1984). The following report summarizes the 2009 hard mast survey. The following personnel assisted with the 2009 hard mast survey: Colby Clark, Josh Clark, Joe Evans, Carrie Gindl, Dan Nolfi, Brad Russell, Bill Stiver, Rick Varner, and Joe Yarkovich.

Methods

Visual surveys (Whitehead 1969) were used to determine the availability and distribution of hard mast. Thirty-four 6.4-km (4.0-mi.) survey routes established in previous years were resampled in 2009. Trees marked with aluminum tags were located using 7.5 minute U.S. Geological Survey topographic maps and a Garmin portable GPS receiver. For each tree sampled, data regarding location, diameter at breast height and species were recorded. Using binoculars, the crown of each tree was surveyed for approximately 30 seconds and an estimate of the percent of visible crown with mast was determined. Using Microsoft Access, mast survey indices were calculated using methods developed by Greenberg and Warburton (2007). Index values $\leq$ 2.00 were classified as poor, 2.01 to 3.00, fair, and $\geq$ 3.00, good (Wentworth 1989). Although a variety of hard mast trees occur in the GRSM (Table 1), only oak trees (*Quercus spp*.) were surveyed since they are considered the most important mast producing trees (Nicholas and White 1984).

Results

The 2009 hard mast survey was conducted from 7 August to 26 August. A total of 540 trees, representing nine oak species were surveyed (Table 1). The mast index value for all oaks was 1.99 indicating poor abundance. White oak and red oak index values were 0.64 and 2.61, respectively (Table 2) suggesting poor and fair abundance for each species group. There was also a significant difference in the percentage of white oak and red oak trees that produced acorns. Only 26.2% (n=55) of the white oak trees surveyed produced visible acorns, whereas, 67.0% (n=221) of the red oak trees surveyed had visible acorns.

Discussion

Mast survey results were very similar to results reported in 2008. Although the mast index value suggested an overall production level that bordered the poor/fair category, the survey indicated that red oak trees produced very well in higher elevations whereas both species groups produced poor in the lower elevations. Anecdotally, it appeared soft mast (e.g., blackberries, blueberries, huckleberries, etc.) was very abundant, particularly in the higher elevations.

The concentrated red oak mast in the higher elevations will likely impact winter hog control efforts. Park wildlife personnel anticipate wild hogs will be concentrated in the less accessible higher elevations during winter, making control efforts more logistically challenging. During fall, bears normally move to the best locations for hard mast. With the abundant mast at the higher elevations, black bear reproduction and cub survival should also be good.

Modifications

Two untagged trees were surveyed to replace trees that were missing tags, damaged or had fallen. Also, tree 412 (scarlet oak) was replaced by tree 49 (chestnut oak); tree 545 (shagbark hickory) was replaced by tree 107 (northern red oak); tree 107a (black oak) was added to the Pretty Hollow Gap trail route; tree 547 (hickory) was replaced by tree 108 (northern red oak); tree 548 (hickory) was replaced by tree 109 (white oak); tree 863 (beech) was replaced by tree 103 (northern red oak); tree 864 (beech) was replaced by tree 104 (northern red oak); and tree 866 (hickory) was replaced by tree 101 (northern red oak).

Suggestions for Future Surveys

Some aluminum tags established on trees in previous years need to be replaced.

Literature Cited

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Table 1. Major hard mast trees of Great Smoky Mountains National Park (Nicholas and White 1984).

Common Name	Scientific Name
WHITE OAKS	
White Oak (85)[1]	Quercus alba
Chestnut Oak (124)	Quercus prinus
Post Oak (1)	Quercus stellata
Chinkapin Oak (0)	Quercus muehlenbergii
Overcup Oak (0)	Quercus lyrata
RED OAKS	
Northern Red Oak (203)	Quercus rubra
Southern Red Oak (7)	Quercus falcata
Scarlet Oak (68)	Quercus coccinea
Black Oak (47)	Quercus velutina
Shingle Oak (3)	Quercus imbricaria
Blackjack Oak (0)	Quercus marilandica
Pin Oak (2)	Quercus palustris
Unidentified Red Oak (0)	Quercus spp.
HICKORIES	
Bitternut Hickory (0)	Carya cordiformis
Mockernut Hickory (0)	Carya tomentosa
Shagbark Hickory (0)	Carya ovata
Pignut Hickory (0)	Carya glabra
Shellbark Hickory (0)	Carya laciniosa
Sweet Pignut Hickory (0)	Carya ovalis
Sand Hickory (0)	Carya pallida
Unidentified Hickory (0)	Carya spp.
WALNUT	
Black Walnut (0)	Juglans nigra
Butternut (0)	Juglans cinerea
BEECH	
American Beech (0)	Fagus grandifolia

[1]Number in parentheses indicates sample size for the 2009 hard mast survey.

Table 2. Hard mast indices (Greenberg and Warburton, 2007) for Great Smoky Mountains National Park, 1979-2009.

Year	White Oak	Red Oak	Total Oak
1979	4.33 (59)[1]	3.19 (61)	3.91 (120)
1980	0.78 (52)	4.00 (74)	2.87 (126)
1981	3.86 (65)	2.32 (88)	3.11 (153)
1982	0.67 (47)	2.23 (82)	1.79 (129)
1983	.	.	.
1984	.	.	.
1985	2.60 (77)	1.90 (83)	2.34 (160)
1986	1.60 (79)	3.04 (93)	2.53 (172)
1987	2.94 (99)	2.62 (116)	2.91 (215)
1988	2.96 (77)	3.21 (166)	3.33 (243)
1989	0.66 (75)	3.08 (160)	2.49 (235)
1990	1.25 (103)	1.61 (112)	1.53 (215)
1991	1.35 (99)	1.05 (147)	1.24 (246)
1992	0.50 (112)	0.85 (155)	0.76 (267)
1993	0.45 (95)	2.67 (155)	1.98 (250)
1994	0.79 (118)	2.20 (142)	1.68 (260)
1995	1.97 (99)	5.04 (167)	4.16 (266)
1996	3.94 (102)	1.87 (156)	2.81 (258)
1997	0.66 (97)	2.76 (165)	2.14 (262)

Table 2. Continued.

Year	White Oak	Red Oak	Total Oak
1998	1.73 (81)	3.77 (171)	3.33 (252)
1999	1.23 (105)	1.29 (150)	1.35 (255)
2000	0.78 (87)	1.61 (163)	1.42 (250)
2001	1.05 (92)	5.10 (165)	3.92 (257)
2002	0.97 (188)	2.38 (317)	1.99 (503)
2003	0.99 (214)	0.80 (312)	0.94 (526)
2004	2.62 (177)	2.25 (331)	2.52 (508)
2005	0.48 (201)	2.24 (329)	1.70 (530)
2006	0.80 (198)	1.33 (315)	1.21 (513)
2007	2.00 (207)	1.67 (321)	1.91 (528)
2008	0.99 (204)	2.10 (319)	1.79 (523)
2009	0.64 (210)	2.61 (330)	1.99 (540)

[1]Number in parentheses indicates sample size for each group of trees.